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EXAMINER	
RALIS, STEPHEN J	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/010,633	LIEW ET AL.	
	Examiner	Art Unit	
	Stephen J. Ralis	3742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 June 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *16,17,20-31,33,35-39,41-45,48,49 and 51* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *26-30* is/are allowed.

6)☒ Claim(s) *16,17,20-25,31,33,35-39,41-45,48,49 and 51* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 November 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Applicant is respectfully requested to provide a location within the disclosure to support any further amendments to the claims.

Response to Amendment/Arguments

3. Applicant's arguments filed 20 June 2007 have been fully considered but they are not persuasive as set forth below:

Allowable Subject Matter

4. Claims 26-30 are allowed.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 24 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled

in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52 USPQ2d 1029, 1033 (Fed. Cir. 1999). The term "non-crystalline amorphous combination" in claim 24 is used by the claim to mean "amorphous", while the accepted meaning is "non-crystalline." The term is indefinite because "non-crystalline" is a characteristic of "amorphous", therefore cannot be used to describe amorphous. Appropriate correction is required.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

9. Claims 16, 17, 20, 22, 23, 31, 35, 37, 38, 43 and 44 are rejected under 35 U.S.C. 102(e) as being anticipated by McPhillips (U.S. Patent No. 6,616,890).

McPhillips discloses a micro-glow plug made from a single ceramic material comprising silicone, carbon and doping with suitable elements including nitrogen (see "silicon carbide SiC" and "N" in lines 6 & 11 of col.2), further comprising a first arm having a first width (see Figure 7), a second arm having a second width (see Figure 7), and a tip having a third width that is less than the first and second widths (see Figure 7),

the first arm and second arm connected to the tip (see Figure 7), a first connecting apparatus for electrically connecting a voltage source across the first arm and the second arm so that when current is applied to the connecting apparatus a current flows through the ceramic heating element (see Figure 7), wherein the current density at the tip is increased due to the decreased third width of the tip (see Figure 7) to generate a high operating temperature at the tip while the first arm and the second arm remain relatively cool (see "hot zone 114"; column 8, line 27).

With respect to the limitations of the ceramic element comprising $Si_xC_yN_z$, where Si is silicon, C is carbon, and N is nitrogen, and x, y and z fall in the following ranges: x=l to 4; y=1.1 to 3.0; and z=0 to 4, McPhillips explicitly discloses the ceramic heating element comprising SiC (silicon carbide particles 100; whole document) that is doped with dopant (108). In addition, McPhillips discloses silicon carbide, or SiC, with the “x” of Si_x and the “y” of C_y being approximately equivalent, since formula SiC inherently has the substantially same mole ratio of silicon and carbon. Furthermore, McPhillips discloses that nitrogen may be used as a dopant, however, focuses on the use of other elements (i.e. aluminum). The “z” mole ratio of the nitrogen mix would be approximately “0” meeting the limitation of “z=0 to 4” of N_z. Therefore, the silicon carbide, SiC, ceramic heating structure fully meets “said ceramic element comprising $Si_xC_yN_z$, where Si is silicon, C is carbon, and N is nitrogen, and x, y and z fall in the following ranges: x=l to 4; y=1.1 to 3.0; and z=0 to 4” given its broadest reasonable interpretation.

With respect to the limitation of the heating element being amorphous $Si_xC_yN_z$, amorphous is defined as being without a regular structure and not having a repeating

crystalline matrix [1]. McPhillips discloses the prior art having grain boundaries or crystalline structure (column 3, lines 41-47; see Figure 1). McPhillips further discloses the ceramic heating element of the invention having particle fused together so as to form no boundaries or being a void free body which would be a non-crystalline structure. Therefore, McPhillips fully meets "wherein the ceramic heating element comprises amorphous $Si_xC_yN_z$" given its broadest reasonable interpretation.

With respect to the limitation of claim 17 and the first width and the second width being substantially equal, McPhillips discloses such a relationship in Figure 7.

With respect to the limitations of claim 31 and the single ceramic material in which the largest dimension is 2 mm or less, and with a glow tip of a size 0.2 mm or less, McPhillips discloses the ceramic heating element structure being as small as 2 grams (Abstract; column 7, line 1-2). Such a small structure, as disclosed in Figure 7 with a low weight (i.e. 2 grams) would inherently have the largest dimension being smaller that 2 mm, with the tip being 0.2 mm or less.

With respect to the limitations of claims 20, 22, 23, 35, 37 and 38 and the ceramic heating element further comprising a metallic element with the metallic element being aluminum or boron, McPhillips further discloses the heating element comprising a metallic element comprising aluminum with Boron, B being an equivalent structure (see "B" and "Al'; column 12, line 7- column 3, line 2).

With respect to the limitations of claims 43 and 44 and using 5.0 or 1.0 watts of power or less to reach and maintain its highest operating temperature, McPhillips discloses the

[1] CeramicMaterials.Info (On-line), Ceramic Glossary Database; Webpage: http://ceramic-

igniter of the invention having much lower power consumption (1-2 W) (column 10, lines 14-18).

10. Claims 31, 41 and 42 are rejected under 35 U.S.C. 102(b) as being anticipated by Boos et al. (U.S. Patent No. 4,205,363

Boos et al. disclose a silicon carbide igniter that is negatively doped with nitrogen in a nitrogen atmosphere (column 8, line 49 – column 9, line 20).

With respect to the limitations of claim 31 and the ceramic element comprising $Si_xC_yN_z$, where Si is silicon, C is carbon, and N is nitrogen, and x, y and z fall in the following ranges: x=l to 4; y=1.1 to 3.0; and z=0 to 4, Boos et al. explicitly disclose the ceramic heating element comprising SiC (silicon carbide powder) that is negatively doped with a nitrogen additional gas dopant (column 8, line 66 –column 9, line 20). In addition, Boos et al. disclose silicon carbide, or SiC, with the "x" of Si_x and the "y" of C_y being approximately equivalent, since formula, SiC, inherently has the same mole ratio of silicon and carbon. Boos et al. explicitly disclose introducing nitrogen into the silicon carbide particle, however, is silent to its contributing factor, therefore, the nitrogen would be approximately "0" and meeting the limitation of "z=0 to 4" of N_z. Therefore, the silicon carbide, SiC, ceramic heating structure fully meets "said ceramic element comprising $Si_xC_yN_z$, where Si is silicon, C is carbon, and N is nitrogen, and x, y and z fall in the following ranges: x=l to 4; y=1.1 to 3.0; and z=0 to 4" given its broadest reasonable interpretation.

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materials.com/cermat/glossary/a.html

With respect to the limitation of the heating element being amorphous, amorphous is defined as being without a regular structure and not having a repeating crystalline matrix [2]. Boos et al. disclose a silicon carbide igniter element that is made of small silicon carbide particle sizes as well as being of high purity (column 4, lines 6-25). Boos et al. further disclose that previous methods result in silicon carbide elements that have pockets of free silicon giving presence to inherent grain boundaries. Boos et al. further disclose the current method of the invention removing the free silicon (impurities) by high heat, pressure and doping resulting in a less-crystalline and stronger structure. Therefore, Boos et al. fully meets "wherein the ceramic heating element comprises amorphous $Si_xC_yN_z$" given its broadest reasonable interpretation.

With respect to the limitations of claim 31 and the single ceramic material in which the largest dimension is 2 mm or less, and with a glow tip of a size 0.2 mm or less, Boos et al. disclose the ceramic heating element structure having preferably a length 0.5 to about 5 cm (5 mm to about 50 mm) with a thickness of 0.015 to about 0.20 cm (0.15 mm to about 2 mm). However, Boos et al. also disclose the power consumption of the igniter being directly related to the surface area of the igniter (column 10, lines 24-30). Boos et al. further disclose another embodiment with the length being from 0.1 to about 5 cm (1 mm to about 5 mm) (column 12, lines 27-30).

With respect to the limitations of claim 41 and 42 and the glow tip reaching a temperature of from 1200°C to 1600°C for ignition, Boos et al. disclose the igniter

[2] CeramicMaterials.Info (On-line), Ceramic Glossary Database; Webpage: http://ceramic-materials.com/cermat/glossary/a.html

reaching temperatures of 1200°C, and 1250°C and 1350°C up to 1700°C (column 11, lines 24-54).

11. Claims 35, 37 and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by Boos et al. (U.S. Patent No. 4,205,363), as evidenced by Shaffer et al. (U.S. Patent No. 6,328,913).

Boos et al. disclose a silicon carbide igniter that is negatively doped with nitrogen in a nitrogen atmosphere (column 8, line 49 – column 9, line 20).

With respect to the limitation of claims 35, 37 and 38 and the ceramic heating element further comprising a metallic element with the metallic element being aluminum or boron, Boos et al. disclose that the use of boron and aluminum, or positive doping elements, may be used. However such a use may have an undesired effect, but nevertheless an effect, on the electrical properties of the igniter (column 4, lines 40-68; column 5, lines 38-55; column 6, lines 42-43). However, a silicon carbide doped with nitrogen igniter, as evidenced by Shaffer et al., may incorporate counter dopant aluminum if a regular temperature coefficient (negative) effect is desired (column 5, lines 65 – column 6, line 3). Since both aluminum and boron are listed synonymous with respect to a positive doping metallic element, both metallic elements with have inherently the same effect.

Joint Inventors – Common Ownership Presumed

12. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

14. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

15. Claims 21, 36, 41, 42 and 45 rejected under 35 U.S.C. 103(a) as being unpatentable over McPhillips (U.S. Patent No. 6,616,890).

With respect to claims 21 and 36, the claim differs from McPhillips in calling for the atom concentration of the metallic element falling within a range of 0.0 to 2.0 for every silicon atom. Firstly, the examiner notes that the range of "0.0 to 2.0" is being interpreted as to "no" atomic concentration of metallic element being present as well as "some" atom concentration of the metallic element. In the first instance (i.e. no atom concentration of the metallic element), McPhillips anticipates the recited claim limitation of "0.0" since the SiC element is doped with the metallic element. With respect to the limitation of "0.1 to 2.0", McPhillips discloses that it is desirable to saturate the SiC with aluminum to provide an even distribution of the dopant species through the entire volume of particle to achieve a saturated SiC particle with aluminum (column 2, lines 49 column 3, line 2). Therefore, the specific amount of the metallic element with respect to the $Si_xC_yN_z$ composition is merely an optimization of a result-effective variable well within the scope of routine experimentation by skilled artisans. It is well settled that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

Regarding the limitations of claims 41 and 42, McPhillips, as described above, discloses all the features claimed except a temperature of 1500°C. It would have been obvious to one having ordinary skill in the art at the time the invention was made, to have a temperature of 1500°C, because McPhillips teaches that how hot the tip's hot

zone can get is "depending on how sharply the designer wishes to define the hot zone 114" (column 8, lines 45-46, also see 114 in Figure 7 of McPhillips).

Regarding the limitations of claim 45, McPhillips, as described above, discloses all the features claimed except reaching glow temperature in 0.5 seconds or less from cold start. It would have been obvious to one having ordinary skill in the art at the time the invention was made, to reach glow temperature in 0.5 seconds or less from cold start, because McPhillips teaches that "the small size of the igniter of the present invention provides several advantages.:, being able to heat up more rapidly to its required use temperature" (column 10, lines 8-9, 12-13). Thus, it would have been obvious to achieve a desired "heat up" time, by choosing the appropriate size of the igniter which would result in such a time.

16. Claims 24 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over McPhillips (U.S. Patent No. 6,616,890) in view of Boos et al. (U.S. Patent No. 4,205,363.

With respect to claims 24 and 39, McPhillips discloses all of the limitations of the claimed invention, as previously set forth, except for calling for the addition of phosphorous in the $Si_xC_yN_z$ composition and specifying the atom concentration of the phosphorous falling within a range of 0.0 to 2.0 for every silicon atom.

However, Boos et al. disclose the addition of further negative dopants, phosphorus, to provide increased resistivity with an inexpensive element as well as a

small atom that is compatible with the silicon carbide crystal structure (column 9, lines 20-30).

In view of Boos et al., it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the addition of phosphorous to provide increased resistivity with an inexpensive element, as well as a small atom, that is compatible with the silicon carbide crystal structure.

With respect to the amount of phosphorous in the composition, Firstly, the examiner notes that the range of "0.0 to 2.0" is being interpreted as to "no" atomic concentration of phosphorous being present as well as "some" atom concentration of the phosphorous. In the first instance (i.e. no atom concentration of the phosphorous), Boos anticipates the recited claim limitation of "0.0" since the SiC element is doped with nitrogen and not phosphorous. With respect to the limitation of "0.1 to 2.0", Boos et al. discloses adding further dopants (i.e. phosphorous; column 9, lines 20-30). The specific amount of the Phosphorous with respect to the $Si_xC_yN_z$ composition is merely an optimization of a result-effective variable well within the scope of routine experimentation by skilled artisans. It is well settled that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

17. Claims 25 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over McPhillips (U.S. Patent No. 6,616,890) in view of Koshkarian et al ('349).

McPhillips discloses all of the limitations of the claimed invention, as previously set forth, except for calling for an oxide coating.

However, an oxide coating on glow plug, as described by Koshkarian, is known in the art. Koshkarian discloses an oxide coating to protect the glow plug against the corrosive/erosive environment (see Abstract). In view of Koshkarian, it would have been obvious to one having ordinary skill in the art at the time the invention was made to provide an oxide coating to protect the glow plug against the corrosive/erosive environment, thereby increasing the operational longevity of the glow plug device.

18. Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Boos et al. (U.S. Patent No. 4,205,363) in view of Koshkarian et al ('349).

McPhillips discloses all of the limitations of the claimed invention, as previously set forth, except for calling for an oxide coating.

However, an oxide coating on glow plug, as described by Koshkarian, is known in the art. Koshkarian discloses an oxide coating to protect the glow plug against the corrosive/erosive environment (see Abstract). In view of Koshkarian, it would have been obvious to one having ordinary skill in the art at the time the invention was made to provide an oxide coating to protect the glow plug against the corrosive/erosive environment, thereby increasing the operational longevity of the glow plug device.

19. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Boos et al. (U.S. Patent No. 4,205,363), as evidenced by Shaffer et al. (U.S. Patent No. 6,328,913).

With respect to claim 36, Boos et al., as evidenced by Shaffer et al., disclose all of the limitations of the claimed invention, as previously set forth, except for calling for the atom concentration of the metallic element falling within a range of 0.0 to 2.0 for every silicon atom. Firstly, the examiner notes that the range of "0.0 to 2.0" is being interpreted as to "no" atomic concentration of metallic element being present as well as "some" atom concentration of the metallic element. In the first instance (i.e. no atom concentration of the metallic element), Boos anticipates the recited claim limitation of "0.0" since the SiC element is preferably not doped with metallic element (i.e. positive doping elements aluminum and boron). With respect to the limitation of "0.1 to 2.0", Boos et al. disclose that the addition of a metallic element such as aluminum and boron as having a positive doping effect. And as evidenced by Shaffer et al, such counter doping is desired and may be achieved with the addition of a metallic element, such as aluminum. Moreover, the specific amount of the metallic element with respect to the $Si_xC_yN_z$ composition is merely an optimization of a result-effective variable well within the scope of routine experimentation by skilled artisans. It is well settled that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

20. Claims 39 and 43-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boos et al. (U.S. Patent No. 4,205,363).

In regards to claim 39, Boos et al. disclose all of the limitations of the claimed invention, as previously set forth, except for calling for the atom concentration of the phosphorous falling within a range of 0.0 to 2.0 for every silicon atom. Firstly, the examiner notes that the range of "0.0 to 2.0" is being interpreted as to "no" atomic concentration of phosphorous being present as well as "some" atom concentration of the phosphorous. In the first instance (i.e. no atom concentration of the phosphorous), Boos anticipates the recited claim limitation of "0.0" since the SiC element is doped with nitrogen and not phosphorous. With respect to the limitation of "0.1 to 2.0", Boos et al. disclose the addition of further negative dopants, phosphorus, since it is inexpensive as well as a small atom that is compatible with the silicon carbide crystal structure (column 9, lines 20-30). Moreover, the specific amount of the phosphorous with respect to the $Si_xC_yN_z$ composition is merely an optimization of a result-effective variable well within the scope of routine experimentation by skilled artisans. It is well settled that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

Regarding claims 43-44, Boos et al. disclose all of the limitations of the claimed invention, as previously set forth, except for calling for using 5.0 or 1.0 watts of power or less to reach and maintain its highest operating temperature. However, Boos et al. disclose power consumption being directly related to the surface area of the igniter (column 10, lines 24-30). Boos et al. further note a large igniter using power of 320

watts (column 10, lines 17-23) and smaller igniters consuming about 24 watts (column 10, lines 7-9) and 11.4 watts (column11, lines 55-62). Boos et al. explicitly disclose the relationship of surface area to power consumption and further provides evidence accordingly. Therefore, the specific amount of power consumption for the micro-glow plug to reach and maintain its highest operational temperature is merely an optimization of a result-effective variable (i.e. surface area) well within the scope of routine experimentation by skilled artisans. It is well settled that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

With respect to the limitation of claim 45, Boos et al. disclose all of the limitations of the claimed invention, as previously set forth, except for calling for reaching its glow temperature in one-half of a second or less from a cold start. However, Boos et al. disclose the amount of time required for an igniter to heat up being directly related to the surface area of the igniter (column 10, lines 24-30). Boos et al. further note a large igniter using power of 320 watts heating up in 30 to 60 seconds (column 10, lines 17-23) while a smaller igniter, consuming about 24 watts, heating up in 2 or 3 seconds (column 10, lines 7-17). Boos et al. explicitly discloses the relationship of surface area to heat up time and further provides evidence accordingly. Therefore, the specific amount of time required for the micro-glow plug to reach and maintain its highest operational temperature is merely an optimization of a result-effective variable (i.e. surface area) well within the scope of routine experimentation by skilled artisans. It is well settled that

where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.

21. Claims 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Willkens et al. (U.S. Patent No. 6,474,492) in view of Cote et al. (U.S. Patent No. 6,195,247).

Willkens et al. disclose a system of micro-glow plugs (MPS) (multiple hot zone igniters; Title) comprising an array of multiple hot zone heater (2 or more) being in a single, integral sintered ceramic igniter element with each hot zone further being isolated electrically and/or thermally by interposed insulative conductive regions (column 1, lines 50-57; see Figures 1, 5).

Wilkins et al. disclose all of the limitations of the claimed invention, as previously set forth, except for calling for an electrical circuit that switches the operation of the micro-glow plugs from one of the micro-glow plugs to the next until all of the micro-glow plugs are exhausted.

However, an electrical circuit that switches from one igniter to the next as each igniter is exhausted, as described by Cote et al., is known in the art. Cote et al. teach a multiple igniter system comprising an exciter circuit comprising a capacitor, circuit for charging the capacitor, one or more igniter plugs in the circuit and a switching mechanism as part of the discharging circuit connected between the capacitor and the igniter (column 1, lines 11-17). Cote et al. further teach a Full Authority Digital Engine

Control (FADEC) that permits automated detection of the exciter failure, and the ability to switch to working exciters in the event of such a failure (column 2, lines 47-49; column 2, lines 16-24). Cote et al. further teach the advantage of such a system provides continued operation despite failure of the exciters, thereby reducing the overall down time of the system (column 1, lines 49-52). In view of Cote et al., it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a control module that provides the ability to detect an igniter failure event and automatically switch to a working igniter in the event of such a failure to provide continued operation despite failure of the igniters, thereby reducing the overall down time of the system.

22. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Willkens et al. (U.S. Patent No. 6,474,492) in view of Cote et al. (U.S. Patent No. 6,195,247) as applied to claim 48 above, and further in view of Frus (U.S. Patent No. 5,155,437).

The Willkens-Cote MPS combination discloses all of the limitations, as described in claim 48 above, except for including a circuit for producing an electrical signal providing information on the remaining expected life of the MPS.

However, a diagnostic system for an igniter system comprising an electrical signal providing information on the remaining expected life of the igniters, as described by Frus, is known in the art. Frus teaches an ignition system comprising and exciter, igniter and diagnostic device (see Figure 1) that further comprises a signal representative of the health status for both the exciter and the igniter that is generated

by an additional monitoring circuit (see Figure 1) in order to diagnose the state of health of the igniter(column 3, lines 4-51) and provide an opportunity for initiating preventive maintenance (column 2, lines 56-64). In view of Frus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the control circuitry to include a state of health monitoring circuit in order to diagnose the state of health of the igniter and provide an opportunity for initiating preventive maintenance.

Response to Arguments

23. With respect to applicant's argument that McPhillips does not disclose the heating element being amorphous $Si_xC_yN_z$, the examiner respectfully disagrees. Amorphous is defined as being without a regular structure and not having a repeating crystalline matrix [3]. McPhillips discloses the prior art having grain boundaries or crystalline structure (column 3, lines 41-47; see Figure 1). McPhillips further discloses the ceramic heating element of the invention having particles fused together so as to form no boundaries or being a void free body which would be a non-crystalline structure. Therefore, McPhillips fully meets "wherein the ceramic heating element comprises amorphous $Si_xC_yN_z$" given its broadest reasonable interpretation.

With respect to applicant's argument that Boos et al. do not disclose the heating element being amorphous $Si_xC_yN_z$, the examiner respectfully disagrees. Again, Amorphous is defined as being without a regular structure and not having a repeating

[3] CeramicMaterials.Info (On-line), Ceramic Glossary Database; Webpage: http://ceramic-materials.com/cermat/glossary/a.html

crystalline matrix [4]. Boos et al. disclose a silicon carbide igniter element that is made of small silicon carbide particle sizes as well as being of high purity (column 4, lines 6-25). Boos et al. further disclose that previous methods result in silicon carbide elements that have pockets of free silicon giving presence to inherent grain boundaries. Boos et al. further disclose the current method of the invention removing the free silicon (impurities) by high heat, pressure and doping resulting in a less-crystalline and stronger structure. Therefore, Boos et al. fully meets "wherein the ceramic heating element comprises amorphous $Si_xC_yN_z$" given its broadest reasonable interpretation. Furthermore as applicant has noted that silicon carbide is crystalline (page 7, last paragraph), the examiner asserts that silicon carbide[5] may also be amorphous silicon carbide (as further noted by Wikipedia). Therefore, the examiners maintains the rejection above.

Conclusion

24. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

[4] CeramicMaterials.Info (On-line), Ceramic Glossary Database; Webpage: http://ceramic-materials.com/cermat/glossary/a.html
[5] Wikipedia (On-line), Amorphous Silicon; Webpage: http://en.wikipedia.org/wiki/Amorphous_silicon

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen J. Ralis whose telephone number is 571-272-6227. The examiner can normally be reached on Monday - Friday, 8:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tu Hoang can be reached on 571-272-4780. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Stephen J Ralis/
Examiner, Art Unit 3742

Stephen J Ralis
Examiner
Art Unit 3742

SJR
February 1, 2008
/TU B HOANG/
Supervisory Patent Examiner, Art Unit 3742